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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/941,533	08/29/2001	Ammar Derraa	MTI-31533	4578

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EXAMINER

FOURSON III, GEORGE R

ART UNIT	PAPER NUMBER
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2823

DATE MAILED: 08/08/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/941,533

Applicant(s)

DERRAA, AMMAR

Examiner

George Fourson

Art Unit

2823

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 01 May 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-73 and 101-129 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-73 and 101-129 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

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Claims 1-3,6-10,35,101,106 and 112 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 35, it appears that - - the - - should precede "heat treatment" unless another step is intended. In claims 1-3,6-10,101,106 and 109-112, it is unclear what is recited through use of "undesirable" because this is not an inherent property of materials. If applicant intends particular properties or function of the material it should be clearly recited.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1,3-9,11,13,14,16,18,19,21,22,24,26,28,30,37,38,49,68,71,101-105,112,120,121 are rejected under 35 U.S.C. 102(e) as being anticipated by Wang et al.

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Wang et al discloses formation of patterned oxide layer 202 having a trench with an aspect ratio of about 7, formation of titanium silicide layer 201 formed by deposition of titanium and annealing, formation of titanium nitride layer 204 by reaction of  $\text{NH}_3$ ,  $\text{TiCl}_4$  and  $\text{H}_2$ , removal of layer 204 by CMP and thermal treatment of layer 204 in  $\text{NH}_3$  containing atmosphere at  $580^\circ\text{C}$  to reduce the chlorine content to 3% by weight to make a contact in plug-fill applications [0037]-[0049].

The reference discloses formation of several titanium nitride layers by repetition of deposition and treatment steps to optimize properties of the composite layer [0049].

Claims 2,12,17,23,27,31,34,35,40-45,114 and 116 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wang et al as applied to claims 1,3,11,13,14,16,18,19,21,22,24,26,28, 30,37,38,49,68,71,101-105,112,120,121 above, and further in view of Hu et al.

Wang et al does not disclose RTA to reduce the chlorine content below 3% by weight.

Hu et al discloses multi-step deposition/treatment of a titanium nitride film using  $\text{NH}_3$ ,  $\text{TiCl}_4$  and  $\text{H}_2$  (col.1, line 67) including RTA at about  $680^\circ\text{C}$  (col. 5, line 6) in  $\text{NH}_3$  (col.4, line 66). The chlorine content would be reduced to the recited extent because the same materials would be treated in the same manner as in the instant invention. Alternatively, one of ordinary skill in the art would have been led to the recited duration and/or conditions of the RTA step to achieve a desired reduction in resistivity (col.5, lines 1-5).

It would have been within the scope of one of ordinary skill in the art to combine the teachings of Wang et al and Hu et al to enable the thermal treatment step of Wang et al to be performed or to obtain the benefits of reducing the contact resistance of the contact as disclosed by Hu et al.

Claim 115 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wang et al in combination with Hu et al as applied to claims 2,12,17,23,27,31,34,35,40-45,114 and 116 above, and further in view of Leem or Japan 5-267220 (Japan '220).

The combination of Wang et al and Hu et al does not include formation of a boron containing titanium nitride film to form the contact.

Leem discloses formation of a high aspect ratio opening, formation of a combination of titanium nitride and titanium boronitride layers (col.5, lines 47-55) to form a contact.

Japan '220 discloses formation of a titanium boronitride barrier layer (abstract and translation page 8) to form a contact.

It would have been within the scope of one of ordinary skill in the art to combine the teachings of Wang et al with the teachings of either one of Leem or Japan '220 to enable formation of the titanium nitride layer of Wang et al having properties disclosed by Leem or Japan '220 associated with the incorporation of boron in the material.

Claims 10,15,20,25,29,32,39,50,51-59,61,62,63,67,66,69,70,73,106,107,108, 109,72,108,109,110,111,113,117,118,119,122 and 123 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wang et al as applied to claims 1,3-9,11,13,14,16,18,19,21,22,24,26,28,30,37,38, 49,68,71,101-105,112,120,121 above, and further in view of Leem or Japan '220.

Wang et al fails to disclose formation of one or more of the alternating layers as a titanium boronitride layer.

Leem or Japan '220 are applied as discussed above as providing motivation to form one or more of the titanium nitride layers of Wang et al using titanium boronitride.

Claims 36,46,47,65 and 64 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wang et al as applied to claims 1,3-9,11,13,14,16,18,19,21,22,24,26,28,30,37,38,49,68,71,101-105,112,120,121 above, and further in view of Doan et al.

Wang et al fails to disclose formation of the  $\text{TiSi}_2$  layer by PECVD or sputtering.

Doan et al discloses formation of a titanium silicide layer by PECVD [0034] or sputtering [0007] to form a contact.

It would have been within the scope of one of ordinary skill in the art to combine the teachings of Wang et al and Doan et al to enable the  $\text{TiSi}_2$  layer of Wang et al to be formed.

Claim 48 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wang et al in combination with Doan et al as applied to claims 36,46,47 and 64 above, and further in view of Hu et al.

The teachings of Wang et al in view of Doan do not include RTA to reduce the chlorine content below 3% by weight

Hu et al discloses multi-step deposition/treatment of a titanium nitride film using  $\text{NH}_3$ ,  $\text{TiCl}_4$  and  $\text{H}_2$  (col.1, line 67) including RTA at about  $680^\circ\text{C}$  (col. 5, line 6) in  $\text{NH}_3$  (col.4, line 66). The chlorine content would be reduced to the recited extent because the same materials would be treated in the same manner as in the instant invention. Alternatively, one of ordinary skill in the art would have been led to the recited duration and/or conditions of the RTA step to achieve a desired reduction in resistivity (col.5, lines 1-5).

It would have been within the scope of one of ordinary skill in the art to combine the teachings of Wang et al and Hu et al to enable the thermal treatment step of Wang et al to be performed or to obtain the benefits of reducing the contact resistance of the contact as disclosed by Hu et al.

Claims 60,124,125,126 and 127 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wang et al as applied to claims 1,3,11,13,14,16,18,19,21,22,24,26,28, 30,37,38,49,68,71,101-105,112,120,121 above, and further in view of applicant's admitted prior art, AAPA.

Wang et al discloses formation of contact to source/drain to have been know prior to applicant's invention [0006].

Applicant admits the process of forming AI interconnects over contacts to have been know prior to applicant's invention (instant pages 1 and 2).

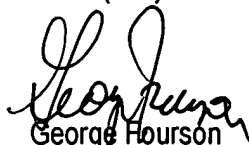
It would have been within the scope of one of ordinary skill in the art to combine the teachings of Wang [0006] and AAPA to enable formation of a source/drain contact and/or an interconnect.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group Receptionist whose telephone number is (703) 308-0956. See MPEP 203.08.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner George Fourson whose telephone number is (703) 308-2544. The examiner can normally be reached on Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (703) 306-2794. The fax number for this group is (703)308-7722 (or extensions 7724, 3431 or 3432) for regular communications and (703)308-7382 for after final communications.

  
George Fourson  
Primary Examiner  
Art Unit 2823

GFourson  
July 27, 2003